
# Terminal Flight Data Manager (TFDM)
# Decision Support Tool (DST) Capabilities Description

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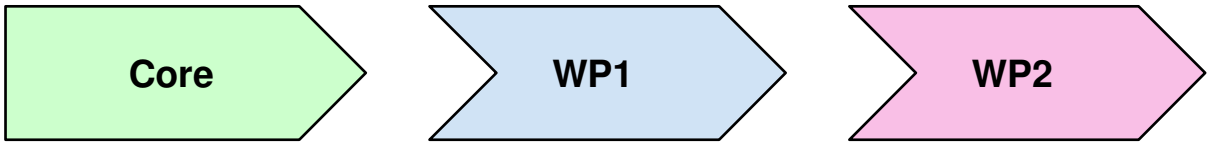
# High-Level DST Capability Roadmap




| Core | WP1 | WP2 |
|---|---|---|
| Capabilities to Enable Electronic Flight Data Management | Interface-related Capabilities | Taxi Routing Capabilities |
| Airport State Capabilities | Prediction-based Capabilities | Conformance Monitoring Capabilities |
| Foundational Surface Scheduling Capability | Throughput Improvement Capabilities | |

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# DST Introduction by Work Package

*NOTE:*
*Uniquely identified DST capabilities represent building blocks of functionality <u>not</u> individual tools*



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# DSTs Introduced in Core and DST

| Core | | |
|---|---|---|
| RN01-TC | Assign departure runway based on pre-defined rules | Enabling Electronic Flight Data Management |
| SS03-TC | Display flight-specific TFM times/constraints and indicators | |
| TX01-TC | Provide queue location and/or intersection departure | |
| AC03-TC | Analyze, implement, and disseminate airport configuration change | Airport State |
| RN08-TC | Provide real-time runway assignment rule management and use | |
| TX10-TC | Manage and display real-time state of runways and taxiways | |
| SS01-TC | Generate runway schedule | Foundational Surface Scheduling |
| SS15-TC | Generate flight state data | |

- **To indicate the TFDM segment, use the following suffixes:**
  - **-TC (TFDM Core)**
  - **-T1 (TFDM Work Package 1)**
  - **-T2 (TFDM Work Package 2)**

Acronym Key
**AC** Airport Configuration; **DR** Departure Routing; **RN** Runway Assignment; **SS** Scheduling and Sequencing; **TX** Taxi Routing



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# DSTs Introduced in Work Package 1

| Work Package 1 | | |
|---|---|---|
| SS11-T1 | Process flight-specific Information from Flight Operators/Ramp Towers | **Interface Centered** |
| RN07-T1 | Process flight-specific departure runway assignment information from flight operators | |
| DR01-T1 | Display flight-specific departure route indicator | |
| SS05-T1 | Estimate flight-specific surface event times | **Prediction Related** |
| SS13-T1 | Monitor surface schedule compliance | |
| SS16-T1 | Process de-icing information and surface schedule impacts | |
| SS17-T1 | Manage Departure Queue Collaboratively with Flight Operators | |
| SS18-T1 | Manage the Surface Departure Schedule Collaboratively with Flight Operators | |
| SS24-T1 | Analyze alternatives for surface management | |
| RN02-T1 | Analyze manually entered runway assignment | |
| RN03-T1 | Balance departure loads on runways | **Throughput Improvement** |
| SS02-T1 | Recommend departure runway sequence | |
| AC01-T1 | Recommend configuration change and time | |
| RN11-T1 | Integrate Wake Turbulence Mitigation for Departures into Runway Assignment | |
| SS22-T1 | Integrate Wake Turbulence Mitigation for Departures into the Surface Schedule | |

Acronym Key
**AC** Airport Configuration; **DR** Departure Routing; **RN** Runway Assignment; **SS** Scheduling and Sequencing; **TX** Taxi Routing



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# DSTs Introduced in Work Package 2

| Work Package 2 | | |
|---|---|---|
| TX01-T2 | Manually assign pre-defined taxi route to a flight | Taxi Routing |
| TX02-T2 | Manually enter and assign ad hoc taxi route to a flight | |
| TX03-T2 | Recommend pre-defined two-dimensional taxi route | |
| TX04-T2 | Recommend non-standard two-dimensional taxi route | |
| TX11-T2 | Monitor conformance to two-dimensional taxi route | Conformance Monitoring |
| TX12-T2 | Monitor aircraft compliance with control instructions | |

Acronym Key
**AC** Airport Configuration; **DR** Departure Routing; **RN** Runway Assignment; **SS** Scheduling and Sequencing; **TX** Taxi Routing



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# Core DST Definitions
## (ordered by DST ID)

**Capabilities to Enable Electronic Flight Data Management**

**Airport State Capabilities**

**Foundational Surface Scheduling Capability**



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# AC03-TC

## Short-Name: Analyze, Implement, and Disseminate Airport Configuration Change

| Description |
| --- |
| This functionality provides limited manual what-if planning to assess the queuing/congestion impact of a single proposed configuration change at specified time. Automation considers forecast traffic and runway loading. Runway closures can be manually entered. Airport configuration planning is not only the physical layout, but includes runway use, resource availability (including runways and taxiways and their segments), and Standard Operating Procedures (SOPs).<br>Results are displayed to facilitate discussion among decision-makers and stakeholders.<br>The automation provides functionality to implement/schedule an airport configuration and configuration change. The last arrival and last departure of current configuration can be manually entered and displayed. First arrival and first departure for new configuration can also be entered and displayed.<br>A Traffic Flow Management System (TFMS) or System-Wide Information Management (SWIM) interface will be used to disseminate airport configuration change information, as these interfaces become available.<br>The automation relies on the SS01-T1C surface modeling and planning functionality.<br>Operational use: Front Line Manager (FLM)/Controller in Charge (CIC)/Traffic Management Coordinator (TMC).<br>Interface/Adaptation notes: pre-determined runway configurations derived from SOP, Letters of Agreement (LOAs), Playbooks. Local adaptation of possible airport configurations required. Airport configuration information is disseminated. |
| Rationale for Core Timeframe: April 2011 meeting between AJT-34 and AJT-133 agreed that this was a Core capability. This is a foundational capability for surface automation. Additionally, implementing airport configuration change has been in surface prototypes. |



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# RN01-TC

## Short-Name: Assign departure runway based on pre-defined rules

| Description |
|---|
| Rule set considerations include factors such as airline, gate, departure fix, destination, aircraft type. This capability generates a runway assignment, based on the rules. Runway assignment is based on airport configuration expected to be active at departure time (as calculated by SS01).<br>Runway assignment is displayed and can be changed by controller with control responsibility for the flight.<br>When the airport configuration changes or any of the considered factors changes, automation updates the runway assignment for flights in the non-movement area. For flights in the Airport Movement Area (AMA), there is a prompt to the controller.<br>Interface/Adaptation notes: runway assignment rules adapted from local SOP, LOA, playbook, airport restrictions, runway to departure fix mapping, noise abatement, and size, weight, or wingspan restrictions of aircraft. Runway assignment is disseminated.<br>Operational use: Ground Controller (GC), Local Controller (LC) and Clearance Delivery (CD). |
| Notes: HF needs to research notification for a non-standard runway assignment; for example from RN03 or RN08. |
| Rationale for Core Timeframe: April 2011 meeting between AJT-34 and AJT-133 agreed that this was a Core capability. This is a foundational capability for surface automation. Additionally, assigning departure runway based on rules has been in surface prototypes. |



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# RN08-TC

## Short-Name: Provide real-time runway assignment rule management and use

| Description |
| --- |
| This functionality provides dynamic management of new rules for the automation to use for runway assignment. Runway assignment rule management includes creation, addition, modification, selection, de-selection, deletion, and override of runway assignment rules.<br>Allows the management of rules and use of the rules and any changes for runway assignment. For Core, the factors for the rule creation are the same as RN01. New runway assignment rules can be created, e.g., cases of runway/taxiway closure, Temporary Flight Restriction (TFR), nearby convective weather.<br>Real-time runway assignment rules in effect can be displayed.<br>Adaptation Notes: same as RN01<br>Operational use by FLM/TMC/CIC, e.g., to map a fix to a different runway, could be a new rule, or could be a temporary override for a period of time. |
| Rationale for Core Timeframe: April 2011 meeting between AJT-34 and AJT-133 agreed that this was a Core capability. RN01 is dependent on managing runway assignment rules. Additionally, runway assignment rules have been in surface prototypes. |



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# SS01-TC

## Short-Name: Generate runway schedule

| Description |
|---|
| This is a foundational function, showing both runway demand and predicted schedule, using as much information as available, including both arrivals and departures. The Core implementation at a minimum uses airline schedule (e.g., Aggregate Demand List (ADL)), proposed and updated departure times, TFM constraint data, departure runway from surface automation, and Airport Surface Detection Equipment-Model X (ASDE-X) surveillance data when available. Arrival runway data will be used as available. This function provides the surface planning and modeling automation.<br>This does not include a display of the runway schedule in front of the local or ground controller.<br>The capability will incorporate TFM constraints/times available electronically to TFDM, such as Expected Departure Clearance Times (EDCTs) via En Route Automation Modernization (ERAM) and departure times from Time Based Flow Management (TBFM). Allows for manual input and update of TFM constraints/times by FLM/TMC/CIC, GC, LC and CD in electronic flight data.<br>Schedules adjust based on changes to runway status, airport configuration changes, runway assignments and rule changes, and flight data updates. Data updates revise the schedule as appropriate.<br>Interface/Adaptation Notes: Surface Schedule is disseminated.<br>Operational use of the runway schedule is by the FLM/TMC/CIC. |
| NOTE: Core will use any schedule data from TFMS, ADL and Traffic Management Advisor (TMA). Surface flight state data (e.g., pushed back or taxiing), can also be used in generating the schedule. Demand does not include runway spacing rules and wake turbulence separation; does not include taxiway congestion. The predicted schedule does account for runway spacing rules, wake turbulence separation, and taxiway congestion. |
| Rationale for Core Timeframe: April 2011 meeting between AJT-34 and AJT-133 agreed that this was a Core capability. SS01 is a foundational capability for surface automation. The TFM constraints/times are an existing interface (or SS01 describes a manual entry capability). Additionally, generating runway schedules and modeling the surface has been in prototypes. |



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# SS03-TC

## Short-Name: Display flight-specific TFM times/constraints and indicators

| Description |
| --- |
| This capability incorporates TFM times/constraints and updates from SS01, to ensure visibility of TFM times/constraints to controllers. The indicator may be a reminder, highlight, or prompt that the constrained time is approaching or that the constrained time has been missed.<br>In Core, the indicator is not predictive.<br>Display to the controller is likely on an electronic flight data display.<br>Operational use by FLM/CIC/TMC, GC, LC and CD. |
| Rationale for Core Timeframe: April 2011 meeting between AJT-34 and AJT-133 agreed that this was a Core capability. SS03 relies on SS01 (for the TFM times/constraints) and the indicator in the Core timeframe is simple (possibly a count-down timer. This addresses a current shortfall and provides immediate benefit of improving situation awareness and reducing controller workload. |



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# SS15-TC

## Short Name: Generate flight state data

| Description |
|---|
| This function generates and updates flight state data and associated times, e.g. flight in taxi to runway, flight in taxi to de-ice pad, flight in line-up and wait state.<br><br>Interface considerations: Flight state data is disseminated.<br><br>Operational use: available for display at all TFDM positions in the tower. |
| Notes: This flight state data can be driven by surveillance data or by flight data updates, including CHI interaction.<br><br>This functionality relies in later timeframes on data received from flight operator. |
| Rationale for Core Timeframe: This capability was not agreed to in the April 2011 AJT-34 and AJT-133 meeting. When reviewing DST capabilities, the DST team felt there were no impediments to a Core implementation and this capability will add value, especially when disseminated to TFM automation. An initial Core implementation can start with surveillance data and simple states and in later timeframes can be enhanced with additional data and flight states. Flight state exists "in back of the panel" in current surface prototypes. |



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# TX01-TC

## Short-Name: Provide queue location and/or intersection departure

| Description |
| --- |
| Automation presents the set of pre-defined queue locations and/or intersection departures applicable to departure runway and the planned airport configuration at the expected departure time. The controller selects the appropriate queue location and or intersection departure, if any.<br>Operational use by GC to assign a queue location or intersection departure to a flight and for situational awareness by GC and LC.<br>Interface/Adaptation notes: pre-determined queue locations and intersection departures for possible runway configurations. |
| Rationale for Core Timeframe: April 2011 meeting between AJT-34 and AJT-133 agreed that this was a Core capability. This capability (essentially the "end of the taxi route" is needed to enhance surface alerts and provides a foundational capability for the taxi route generation capabilities in later timeframes. Additionally, this capability was planned for the DFW prototype. |



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# TX10-TC

**Short-Name:** **Manage and display real-time state of runways and taxiways**

| Description |
| --- |
| This functionality displays current situational awareness information, e.g., a closed taxiway segment due to a disabled aircraft; includes capability for controller entry. Includes both entire taxiways and runways as well as taxiway and runway segments.<br>The functionality provides for manual input to close and re-open taxiways, runways and their segments.<br>Taxiway and runway status are provided on the surface surveillance data and flight data displays.<br>Adaptation for local airport taxiways, runways, and their segments.<br>Operational use: situation awareness for all positions. |
| NOTE: the FLM manages the airport configuration changes. This functionality is provided to controllers for temporary closures and re-opens. |
| Rationale for Core Timeframe: April 2011 meeting between AJT-34 and AJT-133 agreed that this was a Core capability. This capability is linked with the AC03 capability. Extending closing and re-opening to runway and taxiway segments does not unnecessarily over constrain surface resources (e.g., an entire runway or taxiway). Additionally, managing and displaying state of runways and taxiways has been in surface prototypes. |



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# Work Package 1 DST Definitions
## (ordered by DST ID)

**Interface-related Capabilities**

**Prediction-based Capabilities**

**Throughput Improvement Capabilities**



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# AC01-T1

## Short Name: Recommend configuration change and time

| Description |
| --- |
| When there is a demand/capacity imbalance, this capability advises an airport configuration change by indicating the configuration and time of transition. Modeling more fully considers factors such as weather, wind, time of operations (e.g., night operations), and noise control. Interface/adaptation considerations: Uses pre-defined airport configurations; needs airport specific rule-set for conditions/thresholds for configuration change<br><br>Operational use: FLM/CIC/TMC |
| Rationale for WP1. This is not in Core, because the DST team felt it was important to start with AC03 and mature capabilities before implementing "recommending" functionality. AC01-T1 builds on AC03-TC. This capability has been in surface management automation prototypes (Memphis) early 2000's and in the Surface Decision Support System (SDSS), with favorable acceptance. |



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# DR01-T1

## Short Name: Display flight-specific departure route indicator

| Description |
| --- |
| This capability is the display to the tower an indicator showing the results of the evaluation performed by the TFM departure route assessment. The display indicates to all tower positions: 1) that the flight's departure route is blocked, route blockage expected duration, and there are no re-routes or 2) that the flight's departure route is blocked and when to expect a re-route. The display to the FLM/CIC/TMC also includes weather or traffic flow constraints likely to impact a filed departure route.<br><br>Operational use: all TFDM tower positions |
| Rationale for WP1. This is not in Core, because flight specific information will not be available from TFM in the Core timeframe. Additionally, there has been no integrated (surface and TFM) prototyping of this functionality. |



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# RN02-T1

## Short Name: Analyze manually entered runway assignment

| Description |
| --- |
| This functionality provides what-if analysis for a manually-entered runway assignment. The what-if results show the change in the departure schedule and any flight-specific delays.<br><br>Adaptation/interface considerations: Uses appropriate taxi times for airport configuration.<br><br>Operational use: All TFDM positions in the tower. |
| Notes: Usefulness of functionality needs validation via needs analysis/research/HITL. |
| Rationale for WP1. This is not in Core because the capability needs additional analysis and research. This is in WP1 because the capabilities that enable this are in WP1 and because this has not yet been prototyped. This capability builds on foundational runway scheduling and runway assignment capabilities, and is greatly aided by schedule improvements. |



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# RN03-T1

## Short Name: Balance departure loads on runways

| Description |
| --- |
| When adapted for use, this functionality supports balancing departure loads on runways when a capacity/demand imbalance is predicted (SS01). This functionality works in coordination with SS01 (Generate runway schedule) and RN01 (Assign departure runway).<br><br>This functionality can be enabled or disabled by the FLM/CIC/TMC.<br><br>Adaptation/Interface considerations: Thresholds for departure runway capacity/demand imbalances are adapted for the airport. Adaptation needs flexibility to accommodate more than a one-to-one runway-to-departure fix mapping. The departure runway assignment needs to meet departure procedure rules, such as no airborne cross-overs, splitting of departure fixes, and flight paths.<br><br>Operational use: FLM/CIC/TMC can review the runway loading and trigger the implementation of runway load balancing. |
| Notes: Essentially this functionality is a specific enhancement to assign departure runways in order to resolve capacity/demand imbalances when operationally advantageous.<br><br>Automation reassigns runways to load balance for flights before movement area entry. A runway reassignment for load balancing satisfies a flight's TFM constraints. Runway reassignment takes into account flight operator provided acceptable runways. |
| Rationale for WP1. This is in WP1 because the capabilities that enable this are in WP1 or have matured in Core. This capability has not yet been prototyped. It could be in WP1 or WP2, but the decision to put it in WP1 is related to throughput benefits. This capability builds on foundational runway scheduling and runway assignment capabilities, and is greatly aided by schedule improvements. |



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# RN07-T1

## Short Name: Process flight-specific departure runway assignment information from flight operators

| Description |
| --- |
| Flight operators can provide and update flight-specific operationally acceptable runways and departure intersections, e.g. 24L at E7. Flight operators can provide and update ordered runway preferences. Automation will consider flight operator provided information to assign runways. The flight specific operationally acceptable runways, departure intersections, and ordered runway preferences can be available for display to the tower controller.<br><br>Adaptation/Interface considerations: Runway assignment information from flight operators; set of available intersections for departure (airport configuration). Runway assignment preference information is disseminated to NAS domains.<br><br>Operational use: available for display at all TFDM positions in the tower. |
| Notes: Interfaces to flight operators (e.g., CDMnet) already exist. Leverage any existing interfaces as appropriate. As other interfaces become available (e.g., SWIM) they could be used.<br><br>The specific flight operator information elements and timing are TBD.<br><br>It is known that not all flight operators will participate in this data sharing. |
| Rationale for WP1. This is not in Core because it depends on a new interface and also requires development of Surface CDM (Collaborative Decision Management) data standards, data exchange, and policy. This capability has not been prototyped. |



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# RN11-T1

## Short Name: Integrate Wake Turbulence Mitigation for Departures into Runway Assignment

| Description |
|---|
| Assumptions:. 1) Wake Turbulence Mitigation for Departures (WTMD) status information for a runway (e.g., available, off, or enabled) is on a TFDM display, similar to altimeter. 2) WTMD information is displayed to GC, LC and FLM/CIC/TMC, at a minimum.<br><br>This functionality integrates WTMD information into runway assignments. WTMD status (enabled or off) is transmitted to the runway assignment automation. When FLM/CIC enables WTMD, the runway assignment automation takes into account WTMD information to assign runways. When WTMD status is off, it is no longer used to assign runways. When the WTMD status changes from enabled to off, the status change does not result in any runway assignment changes by the automation to flights in the AMA.<br><br>Adaptation/interface considerations: Locally adapted for airport. Interface for WTMD status information.<br><br>Operational use: GC, LC and FLM/CIC/TMC<br><br>NOTE: TFDM subsumption of WTMD display and user interface needs further clarification. There is a separate capability (SS22) to add information that can be processed by SS01 to modify the surface schedule. |
| This capability is contingent on WTMD investment and acquisition process. (Spawned from SS22; additional throughput benefits can be gained by assigning runway to take advantage of WTMD)<br><br>Follow-up with WTMD programmatic dependency needed. |
| Rationale for WP1. This is not in Core because this functionality is a new interface and also requires development WTMD functionality. The decision was made to describe the capability for WP1 because of a one of TFDM's primary objectives: to eliminate the multiple systems and monitors in the tower. RN11 has not been prototyped. If WTMD is not ready for the TFDM WP1 timeframe, the capability description would not change in a later timeframe. |



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# SS02-T1

## Short Name: Recommend departure runway sequence

| Description |
| --- |
| This capability supports the automated generation of sequencing recommendations for a runway.<br><br>Automation generates a sequence recommendation (e.g., recommended order of flights for efficient throughput) based on flight data, and sequencing rules (adapted for the airport) such as splitting departure fixes, TFM constraints, controlled departure times, wake turbulence spacing requirements, and initial departure separation requirements. Automation also takes into account flight-operator provided information such as flight priorities or departure intersection capabilities.<br><br>Automation displays the recommended order of flights.<br><br>Interface/Adaptation: Sequencing rules and weighting for factors for airport configurations, intersection departure rules for sequencing for airport configurations.<br><br>Operational Use: GC, LC to execute the departure runway sequence, FLM/CIC/TMC. |
| Rationale for WP1. This is in WP1 because the capabilities that enable this are in WP1 or have matured in Core. This capability relies on flight operator inputs and is also greatly aided by schedule improvements. This capability has not yet been prototyped. It could be in WP1 or WP2, but the decision to put it in WP1 is related to throughput benefits. |



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# SS05-T1

## Short Name: Generate flight-specific surface event times

| Description |
|---|
| This functionality generates flight-specific times from surface automation modeling for event times/windows, such as off-block time, movement area entry time, and departure time, to meet the planned surface schedule (SS01), to be in compliance with any TFM controlled departure times, and to include criticality of the constraint/schedule. Surface event times are updated as the surface model (SS01) is updated.<br><br>Surface event times to meet the planned surface schedule are 1) provided to the flight operator (e.g., ramp tower) and 2) are displayed to TFDM tower positions. In the future the event times may also be sent to the aircraft.<br><br>Operational use: all TFDM positions in tower |
| Notes: The surface event times generated by SS05-T1 represent reasonable event times that if executed will meet the overall surface schedule.<br><br>Notes for SS01 enhancements for WP 1 timeframe: additional variables to model the schedule: adaptation considerations: nominal times for gate to runway; adding these other variables to model the schedule. |
| Rationale for WP1. This is in WP1 because the accuracy for the output generated by this capability is dependent on the inputs and functionality of SS11. This capability has not yet been prototyped. It could be in WP1 or WP2. This is integrated with schedule improvements and predictions. |



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# SS11-T1

## Short Name: Process Flight-specific Information from Flight Operators/Ramp Towers

| Description |
|---|
| This function receives data from the flight operator/ramp tower and uses that data in generating the surface schedule (SS01). The detailed data from flight operators/ramp towers includes data such as parking location, off-block time, flight priorities, gate conflicts, and aircraft de-icing information. The data include estimates, updates, and actuals. In the future, possibly some of the data could come directly from the aircraft.<br><br>Interface/adaptation considerations: flight operator data sharing mechanism.<br><br>Operational use: Available for display at all TFDM positions. |
| Notes: Interfaces to flight operators (e.g., CDMnet) already exist. Leverage any existing interfaces as appropriate. As other interfaces become available (e.g., SWIM) they could be used.<br><br>TBD the specific flight operator information and timing is critical to improving the schedule.<br><br>It is known that not all flight operators will participate in this data sharing. |
| Rationale for WP1. This is not in Core because it depends on a new interface and also requires development of Surface CDM (Collaborative Decision Management) data standards, data exchange, and policy.<br><br>In the STBO prototype field demonstrations and evaluations in Memphis, a smaller dataset than described above was received from Delta and FedEx and the data was used in Scheduling and Sequencing capabilities |



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# SS13-T1

## Short Name: Monitor surface schedule compliance

| Description |
|---|
| This capability is closely related to SS03, which addresses TFM constraints/times. The capability relates to the surface schedule when metering with SS18 and/or to the off-block times and times at the spot for flights with TFM constraints/times. The functionality can both detect and predict non-compliance with the flight's departure time, time at the spot, and off block time.<br><br>This capability displays a notification to the controller and shares predicted and actual non-compliance data with the flight operator/ramp tower.<br><br>Interface/Adaptation: Share data with flight operator and ramp tower; nominal taxi route times; airport configuration<br><br>Operational Use: GC, LC, and FLM/CIC/TMC when metering with SS18 and/or for flights with TFM constraints/times. |
| Notes: Human interaction is needed to resolve the schedule problem or update times for the flight.<br><br>SS03-TC needs to be enhanced for WP1 to predict not meeting TFM constraints, to send an alert to TFM automation; and to send an alert to the flight operator. |
| Rationale for WP1. This capability is not in Core because the functionality of Core is not sufficient and because it is too complex. This is in WP1 because the capabilities that enable this are in WP1. This capability has not yet been prototyped. This capability relies on schedule improvements and predictions of WP1. |



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# SS16-T1

## Short Name: Process de-icing information and surface schedule impacts

| Description |
|---|
| This capability processes flight-specific de-icing information from flight operators (see SS11), airport configuration information for de-icing, and predicted and actual de-icing queues. The functionality provides de-icing impacts and timing information to SS01 to be reflected in the surface schedule. Flight-specific de-icing information is displayed.<br><br>Adaptation/interface considerations: Airport configuration for de-icing procedures; airport adaptation for de-icing pads; nominal times for de-icing and for taxi routes to de-ice pads and from de-ice pads to runways, if de-ice pads in movement area. Relies on flight operator provided data such as a flight needs de-icing, deice pad the flight will use, de-icing completion, and holdover time.<br><br>Operational use by all TFDM positions in the tower. |
| De-ice pad may be in the ramp area or in the movement area. Assumes responsibility for deicing remains the flight operator's. |
| Rationale for WP1. This is in WP1 and not Core because it depends on a new interface and is more complex than is suitable for Core and because of because the capabilities that enable this are in WP1. This capability has not yet been prototyped. This capability relies on schedule improvements and predictions of WP1. |



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# SS17-T1

## Short Name: Manage Departure Queue Collaboratively with Flight Operators

| Description |
| --- |
| This function provides automation to Manage Departure Queue Wait Time through an aggregate allocation of the number of flights that can enter the movement area to individual flight operators during a specific time interval conducted on a runway by runway basis and/or metering category basis. A metering category is a resource that is capacity constrained, such as a departure fix and/or runway. The goal is for equitable distribution of delay among all flight operators within metering categories.<br><br>The flight operator response indicates the use of its allocation, which is displayed in the tower. Flight operators will be responsible for movement area entry at times that ensure flights depart within applicable controlled departure time windows.<br><br>A flight operator's non-compliance with SS17 is monitored and addressed.<br><br>Operational use: flight operators, ramp towers, all TFDM positions in the tower<br><br>Adaptation/interface considerations: Adaptation considerations include metering categories, local airport configuration, runway-fix mapping. |
| Notes: Details and procedures for non-compliance need additional work. |
| Rationale for WP1. This is in WP1 and not Core because of more complexity than is suitable for Core and because of because the capabilities that enable this are in WP1, as well as needed data exchange with the flight operator. This capability has had several field demonstrations and evaluations at MEM with FedEx and Delta, supported by SDSS. This capability relies on schedule improvements and predictions of WP1. |



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# SS18-T1

## Short Name: Manage the Surface Departure Schedule Collaboratively with Flight Operators

| Description |
| --- |
| This function provides automation to manage the departure surface schedule by generating flight-specific movement area entry times in metering categories that consider all applicable constraints, such as EDCTs. A metering category is a resource that is capacity constrained, such as a departure fix and/or runway.<br><br>Automation provides the flight operator flight-specific movement area entry times. The flight operator has flexibility to reallocate flights within the same metering category to one of the flight operator's movement area entry timeslots. The flight operator sends the results of any reallocation, e.g., flights and associated timeslots, which update the surface schedule. Flight operators will be responsible for movement area entry at times that ensure flights depart within applicable controlled departure time windows. The flight-specific movement area entry times are displayed to the tower.<br><br>Operational use: flight operators, ramp towers, all TFDM positions in the tower<br><br>Adaptation/interface considerations: Electronic transmission capabilities are not required; communication between tower and flight operators may be by voice. Adaptation considerations include metering categories, local airport configuration, runway-fix mapping, TFM constraints. |
| Notes: The departure surface schedule is based on flight operator provided data. |
| Rationale for WP1. This is in WP1 and not Core because of more complexity than is suitable for Core and because of because the capabilities that enable this are in WP1, as well as needed data exchange with the flight operator. Prototype development of this capability in SDSS is underway for later field demonstrations and evaluation at MCO. |



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# SS22-T1

## Short Name: Integrate Wake Turbulence Mitigation for Departures into the Surface Schedule

| Description |
| --- |
| Wake turbulence mitigation for departures (WTMD) is integrated into the surface schedule (SS01). When a runway is enabled (by FLM/CIC/TMC, automation updates departure times based on WTMD times. When WTMD is turned off, departure times are updated to non WTMD departure procedures.<br><br>Adaptation/Interface notes: Locally adapted for airport.<br><br>Operational use: LC for departing aircraft; all TFDM positions for schedule updates |
| This capability is contingent on WTMD investment and acquisition process.<br><br>Follow-up with WTMD programmatic dependency needed. |
| Rationale for WP1. This is not in Core because this functionality is a new interface and also requires development of WTMD functionality. The decision was made to describe the capability for WP1 because of a major TFDM objective: to eliminate the multiple systems and monitors in the tower. SS22 had not been prototyped. If WTMD is not ready for the TFDM WP1 timeframe, the capability description would not change in a later timeframe. |



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# SS24-T1

## Short Name: Analyze alternatives for surface management

| Description |
| --- |
| This functionality notifies the FLM/CIC/TMC when there will be a problem with surface capacity based on demand. The automation supports what-if analysis and shows the capacity/demand comparison of applying and/or combining different alternatives such as airport configuration change, changing runway-fix mapping, runway load balancing, CDQM/CDS, sequencing for throughput improvement, while satisfying TFM constraints.<br>FLM/CIC/TMC provides inputs for -alternatives that require parameters, such as airport configuration or runway-fix mapping,<br>Adaptation/interface considerations: TFDM is adapted for the airport to identify what alternatives can be used to address the problem; capacity/demand thresholds to define the problem state (duration, severity, etc.).<br>Operational use: FLM/CIC/TMC |
| Notes: Arrivals are taken into consideration. Parameters for alerting thresholds can be established for notification.<br>This is a new capability.<br>WP1 provides what-if analysis. Recommendation/optimization functionality should be considered in WP3+ |
| Rationale for WP1. This is a new surface capability. The components to support this capability are in place in WP1. This capability has not been prototyped. There is an associated capability, SS06 – Optimize the use of surface resources and the overall surface plans and schedule. The DST Team felt it was important to have an intermediate step with the FLM/CIC/TMC in the loop, before going to optimization. In this capability, the FLM/CIC/TMC will review alternatives and decide among them, for example: to change runway-fix mapping or to schedule a configuration change or to implement collaborative departure scheduling. |



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# Work Package 2 DST Definitions
## (ordered by DST ID)

**Taxi Routing Capabilities**

**Conformance Monitoring Capabilities**



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# TX01-T2

## Short Name: Manually assign pre-defined taxi route to a flight

| Description |
| --- |
| This functionality provides for manual assignment of pre-defined taxi routes to individual flights by tower personnel. Automation presents the set of pre-defined taxi routes, based on the flight's characteristics, surface location and destination and airport configuration. Automation takes into account closed taxiways or taxiway segments. An airport configuration change may result in and display an indicator for a taxi route update.<br><br>This capability is foundational to support surface conformance monitoring. This capability does not support aircraft-aircraft de-confliction.<br><br>The controller can modify a pre-defined taxi route. The controller assigns a taxi route to the flight manually and issues the clearance.<br><br>Adaptation considerations: pre-defined taxi routes are defined, stored and managed for each airport configuration to handle departures, arrivals, routes to de-ice pads, maintenance re-positions, and hold shorts when the taxi route crosses a runway and other hold shorts (e.g., an taxi intersection as a sequencing merge point). Pre-defined taxi routes can include published, coded taxi routes.<br><br>Interface considerations: Needs flight starting location, such as gate or current position, and surface destination, such as runway, gate, or maintenance hangar. Flight operator provides parking location (SS11).<br><br>Operational use by GC and LC; display of taxi route available for all TFDM positions. |
| Notes: taxi route can be displayed as part of flight data. SS01 needs nominal times for pre-defined taxi routes to enhance the surface schedule.<br><br>TX01-T2 is in addition to TX01-TC. |
| Rationale for WP2: This capability is part of the taxi route generation/surface conformance monitoring group and could be in WP1 or WP2. The AJT DST Team decided to assign these 6 TX capabilities to WP2 and the other 15 capabilities in WP1. This has been prototyped and was the subject of 3 lab HITLs. |



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# TX02-T2

## Short Name: Manually enter and assign ad hoc taxi route to a flight

| Description |
|---|
| This capability provides for manual entry and assignment of ad hoc taxi routes by tower personnel who consider the flight's characteristics, surface location and destination and airport configuration. Automation assistance can facilitate taxi route entry by providing for example, taxi segments and acceptable alternatives or route completion. An ad hoc route can be a manual modification to a pre-defined route. The automation verifies the acceptability of the ad hoc route with respect to open and closed taxiways and taxiway segments, hold shorts for crossing the runway, and taxiway use rules, e.g., direction of taxi. An airport configuration change may result in and display an indicator for a taxi route update.<br><br>The controller assigns a taxi route to the flight manually and issues the clearance.<br><br>The functionality provides for entering the taxi route once and using it once or entering and re-using the taxi route.<br><br>Adaptation considerations: airport configuration; taxi segments<br><br>Operational use by GC and LC; display of taxi route available for all TFDM positions. |
| Notes: taxi route can be displayed as part of flight data. This capability is foundational to support surface conformance monitoring. |
| Rationale for WP2: This capability is part of the taxi route generation/surface conformance monitoring group and could be in WP1 or WP2. The AJT DST Team decided to assign these 6 TX capabilities to WP2 and the other 15 capabilities in WP1. This has been prototyped. |



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# TX03-T2

## Short Name: Recommend pre-defined two-dimensional taxi route

| Description |
|---|
| This capability provides automated recommendation of a pre-defined two-dimensional taxi route for a flight, without time dimension. The recommended pre-defined route includes hold shorts when the taxi route crosses a runway and other hold shorts (e.g., a taxi intersection used as a sequencing merge point).<br>The capability does not consider aircraft-aircraft deconfliction. The controller may select another predefined taxi route (TX01-T2), may enter an ad hoc taxi route (TX02), or can modify the pre-defined route. An airport configuration change may result in and display an indicator for a taxi route update.<br>Adaptation/interface considerations: airport/aircraft specific rules for assigning flight-specific taxi routes; rules for ranking of routes; aircraft parking location; hold shorts for crossing a runway.<br>Operational use: GC issues the taxi route; display of taxi route available for all TFDM positions. |
| Notes: Ranking could be part of the recommendation. The automated taxi route recommendation can be displayed in the flight data. Basic predefined taxi routes are adapted in TX01-T2. This capability could expand/enhance predefined routes in adaptation. Aircraft location from surveillance in movement area or flight-operator provided parking location.<br>Dependent on closed taxiways/taxiway segments (TX10)<br>Consider WP3+ for TX03 enhancement for optimization in future. |
| Rationale for WP2: This capability is part of the taxi route generation/surface conformance monitoring group and could be in WP1 or WP2. The AJT DST Team decided to assign these 6 TX capabilities to WP2 and the other 15 capabilities in WP1. This capability has been prototyped and was the subject of 3 lab HITLs. The original capability described an optimized taxi route, however, the DST Team felt it was prudent to gain acceptability of recommendations and to mature the capability before addressing optimization. |



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# TX04-T2

## Short Name: Recommend non-standard two-dimensional taxi route

| Description |
|---|
| This capability provides automated recommendation of a non-standard (i.e., not pre-defined) two-dimensional taxi route for a flight, without time dimension, from its surface location to its surface destination. When the route crosses a runway, a hold-short is inserted in the route. The capability does not consider aircraft-aircraft deconfliction. The controller can modify the recommended non-standard route, select a predefined taxi route (TX01-T2) or may enter an ad hoc taxi route (TX02). The automation takes into account open and closed taxiways and taxiway segments, hold shorts for crossing a runway, and taxiway use rules, e.g., direction of taxi. An airport configuration change may result in and display an indicator for a taxi route update.<br><br>Adaptation/interface considerations: airport/aircraft specific rules for assigning flight-specific taxi routes/segments; rules for ranking of routes; aircraft parking or current location and its destination. Adaptation has site-specific taxiways and taxiway segments.<br><br>Operational use: GC issues the taxi route; display of taxi routes available for all TFDM positions. |
| Notes: Ranking could be part of the recommendation. The display of the automated taxi route recommendation can be populated in the flight data. Aircraft location from surveillance in movement area or flight-operator provided parking location. This could be used for new taxi route when runway is reassigned while flight is in the movement area or could be the solution to a non-conformance.<br><br>Dependent on closed taxiways/taxiway segments (TX10)<br><br>Consider WP3+ for TX04-T2 enhancement for optimization in future and WP3+ for aircraft deconfliction. |
| Rationale for WP2: This capability is part of the taxi route generation/surface conformance monitoring group and could be in WP1 or WP2. The AJT DST Team decided to assign these 6 TX capabilities to WP2 and the other 15 capabilities in WP1. Originally, this was cast as optimized route, however, the DST Team felt it was prudent to gain acceptability of recommendations and to mature the capability before addressing optimization. This has not been prototyped. |



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# TX11-T2

## Short Name: Monitor conformance to two-dimensional taxi route

| Description |
|---|
| This functionality supports monitoring conformance to a flight's two-dimensional taxi route. Automation monitors aircraft position with respect to the known taxi route and notifies the controller if the aircraft deviates from the lateral taxi route. The alerting notification is based on non-conformance severity.<br><br>Adaptation/interface considerations: potential known low performance spots if surveillance not adequate needs to be taken into account in the automation. Airport adaptation for conformance areas and boundaries.<br><br>Relies on surveillance with adequate performance to determine aircraft position for conformance monitoring; also relies on TX01-T2,TX02, TX03, or TX04 for taxi route.<br><br>Operational use by GC and LC and display to FLM/CIC/TMC |
| Notes: Prediction of noncomformance by taking heading and speed into account is in WP3+<br><br>Conformance monitoring for hold shorts and control instructions (e.g., is covered in TX12-T2) |
| Rationale for WP2: This capability is part of the taxi route generation/surface conformance monitoring group and could be in WP1 or WP2. The AJT DST Team decided to assign these 6 TX capabilities to WP2 and the other 15 capabilities in WP1. This has been prototyped and was the subject of 3 lab HITLs. |



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# TX12-T2

## Short Name: Monitor aircraft compliance with control instructions

| Description |
| --- |
| This functionality supports monitoring aircraft compliance with known control instructions such as hold short, line up and wait, and cleared for take off and notifies the controller when automation detects aircraft deviation from the control instruction. The alerting notification is based on non-conformance severity.<br><br>Adaptation/interface considerations: potential known low performance spots if surveillance not adequate needs to be taken into account in the automation. Airport adaptation for conformance areas and boundaries.<br><br>Relies on surveillance with adequate performance to determine aircraft position for conformance monitoring; also relies on surveillance, TX01-T2, TX02, and TX03 for hold short instructions and on flight state data updates.<br><br>Operational use by GC and LC |
| Notes: Expanded from original capability with only hold-shorts to other control instructions. |
| Rationale for WP2: This capability is part of the taxi route generation/surface conformance monitoring group and could be in WP1 or WP2. The AJT DST Team decided to assign these 6 TX capabilities to WP2 and the other 15 capabilities in WP1. This has been prototyped and was the subject of one lab HITL. |



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# Work Packages and DSTs

| Core | |
|---|---|
| AC03-TC | Analyze, implement, and disseminate airport configuration change |
| RN01-TC | Assign departure runway based on pre-defined rules |
| RN08-TC | Provide real-time runway assignment rule management and use |
| SS01-TC | Generate runway schedule |
| SS03-TC | Display flight-specific TFM times/constraints and indicators |
| SS15-TC | Generate flight state data |
| TX01-TC | Provide queue location and/or intersection departure |
| TX10-TC | Manage and display real-time state of runways and taxiways |

| Work Package 1 | |
|---|---|
| AC01-T1 | Recommend configuration change and time |
| DR01-T1 | Display flight-specific departure route indicator |
| RN02-T1 | Analyze manually entered runway assignment |
| RN03-T1 | Balance departure loads on runways |
| RN07-T1 | Process flight-specific departure runway assignment information from flight operators |
| RN11-T1 | Integrate Wake Turbulence Mitigation for Departures into Runway Assignment |
| SS02-T1 | Recommend departure runway sequence |
| SS05-T1 | Estimate flight-specific surface event times |
| SS11-T1 | Process flight-specific Information from Flight Operators/Ramp Towers |
| SS13-T1 | Monitor surface schedule compliance |
| SS16-T1 | Process de-icing information and surface schedule impacts |
| SS17-T1 | Manage Departure Queue Collaboratively with Flight Operators |
| SS18-T1 | Manage the Surface Departure Schedule Collaboratively with Flight Operators |
| SS22-T1 | Integrate Wake Turbulence Mitigation for Departures into the Surface Schedule |
| SS24-T1 | Analyze alternatives for surface management |

| Work Package 2 | |
|---|---|
| TX01-T2 | Manually assign pre-defined taxi route to a flight |
| TX02-T2 | Manually enter and assign ad hoc taxi route to a flight |
| TX03-T2 | Recommend pre-defined two-dimensional taxi route |
| TX04-T2 | Recommend non-standard two-dimensional taxi route |
| TX11-T2 | Monitor conformance to two-dimensional taxi route |
| TX12-T2 | Monitor aircraft compliance with control instructions |

| Acronym Key | |
|---|---|
| AC | Airport Configuration Management |
| DR | Departure Routing |
| RN | Runway Assignment |
| SS | Scheduling and Sequencing |
| TX | Taxi Routing |

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# Glossary in progress

| | | | |
|---|---|---|---|
| **AC** | Airport Configuration Management | **RN** | Runway Assignment |
| **ADL** | Aggregate Demand List | **SOP** | Standard Operating Procedures |
| **AJT** | Terminal Services | **SDM** | Surveillance Data Manager |
| **AMA** | Airport Movement Area | **SS** | Scheduling and Sequencing |
| **ASDE-X** | Airport Surface Detection Equipment-Model X | **STBO** | Surface Trajectory-Based Operations |
| **CD** | Clearance Delivery | **SWIM** | System-Wide Information Management |
| **CD** | Clearance Delivery | **T1** | TFDM Work Package 1 |
| **CIC** | Controller in Charge | **T2** | TFDM Work Package 2 |
| **DR** | Departure Routing | **TBFM** | Time Based Flow Management |
| **DST** | Decision Support Tool | **TC** | TFDM Core |
| **EDCT** | Expected Departure Clearance Time | **TFDM** | Terminal Flight Data Management |
| **ERAM** | En Route Automation Modernization | **TFM** | Traffic Flow Management |
| **FDM** | Flight Data Manager | **TFMS** | Traffic Flow Management System |
| **FLM** | Front Line Manager | **TFR** | Temporary Flight Restriction |
| **GC** | Ground Controller | **TMC** | Traffic Management Coordinator |
| **LC** | Local Controller | **TMA** | Traffic Management Advisor |
| **LOA** | Letter of Agreement | **TMC** | Traffic Management Coordinator |
| **NAS** | National Airspace System | **TX** | Taxi Routing |
| | | **WTMD** | Wake Turbulence Mitigation for Departures |



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